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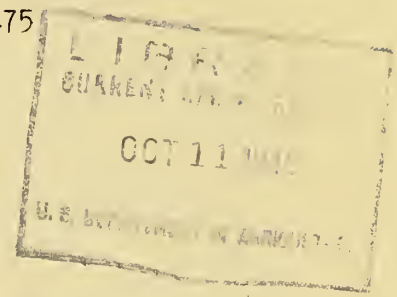


# TESTS ON THE TRANSPORTATION OF PEACHES FROM COLORADO, AUGUST 1946
From Grand Junction, Colo. to Lincoln, Neb. and Minneapolis, Minn.

By

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Beltsville, Maryland

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Because of the rapid expansion of the peach growing industry in Western Colorado it is apparent that an extension of the marketing area is needed and ways and means of reaching more distant markets than are now served would be desirable. Methods of getting riper and better quality peaches to the markets in order to stimulate consumer demand also seem to be desirable.

A request for the work along these lines was initiated at a meeting of the Western Colorado Horticultural Society at Grand Junction in January 1946. It was endorsed by the Mesa County Research Committee and the Peach Board of Control and was transmitted to the U. S. Department of Agriculture by Professor A. M. Binkley, Head of the Department of Horticulture, Colorado State College, with offer of cooperation and assistance in conducting the tests. Before describing the work undertaken and discussing the results it is appropriate to make special acknowledgement of the help rendered by Professor Binkley in making preliminary arrangements with the various interests concerned. He was also most helpful in organizing the program of tests, cooperating with D. F. Fisher, Principal Horticulturist, Bureau of Plant Industry, under whose general direction the work was conducted. Acknowledgements to others who cooperated will be found at the end of this report.

The purpose of the summary that follows is to give a brief report of the most outstanding results for the benefit of cooperators and others interested. Most of the conclusions that may be drawn from these results are necessarily largely tentative. Further work is needed to get information that could not be obtained under the conditions prevailing during these tests and to obtain a sounder basis for drawing conclusions.

## Plan of Tests and Description of Methods Used

All of the tests made were with Elberta peaches and were of 2 general kinds:

1. Carlot shipments (5 cars) in which no test lots were included but sample packages from the commercial consignments were inspected at destination. These were packed in bushel baskets and standard peach boxes. A record of transit temperatures was obtained by use of Ryan recording thermometers.

2. Carlot shipments of boxed peaches (9 cars) containing test lots of two stages of ripeness for comparison after unloading at destination. These cars were in the same train to the same destination and were accompanied by observers who recorded data on temperatures inside and outside the cars during transit, ice supplied to the cars and other pertinent information obtained during the trip and after arrival at Minneapolis, Minnesota.

1. Unaccompanied shipments. Three of the 5 unaccompanied cars were standard end-bunker cars as customarily furnished to shippers; 2 were similar cars but equipped with Preco fans to provide forced air circulation through the load during transit. The principal object of these tests was to determine the effect of replenishing the ice at Grand Junction after loading on the rate of cooling of the loads during transit, particularly when the peaches were in bushel baskets. One car loaded with peaches in 16 lb. lugs was included for comparison. All 5 cars were shipped to Lincoln, Nebraska where the recording thermometers were removed and inspections were made by Dr. H. O. Werner of the University of Nebraska whose helpful cooperation is gratefully acknowledged.

A recording thermometer (about the same shape and size as an ordinary 1-lb. baking powder can) was placed near the center of a package in both top and bottom layers at the doorway position near the centerline of the cars. The cars containing baskets were loaded 6 rows wide and 4 layers high. The rows were offset lengthwise of the car with 22 baskets in each row, making a total load of 528. The car with 16-pound lugs contained a total of 1400 packages loaded 7 wide with 1 to 2 inches of space between the rows and between the outer rows and the car walls. They were loaded 10 layers high and stripped every second or third layer. There were 10 stacks in one end and 11 in the other end of the car with about a 3 foot bulkhead at the doorway. The cars used in these tests, time of icing, the size of the loads and other data pertinent thereto are listed in Table 1.

2. Accompanied shipments. The 9 cars that were accompanied by observers were all loaded with wrapped peaches packed in 16 pound lugs and were shipped to Minneapolis, Minnesota. The cars were loaded as described above except that most of the end-bunker cars had 10 stacks in each end and the overhead bunker car had 12 stacks in one end and 13 in the other.

The main objects of this test were (1) to obtain additional information relative to the effect of replenishing the ice at Grand Junction; (2) to determine the influence of precooling and the addition of salt to the ice at reicing on the temperature of the fruit in transit and (3) to compare the efficiency of standard end-bunker cars, fan cars, and overhead bunker cars in the transportation of peaches.

All of the cars in this test were initially iced at Grand Junction on the morning of August 28 and loaded during that day. The cars used, size of loads, time of icing, and other pertinent data are listed in table 2. All cars were shipped under standard refrigeration with modifications as noted in table 2.

The commodity temperatures at one end of the cars were determined by means of electric resistance thermometers placed at 12 positions in the load as shown in table 3. At the start of the test the thermometers were placed in the west or rear end of each car and on the south side. However, the cars were reversed at Denver so that the thermometers were in the east end and north side. The cars were again reversed at Des Moines, Iowa so that the thermometers were in the south end and east side of the cars from there on. Outside air temperature records were obtained by reading mercury thermometers at intervals and by means of a Ryan recording thermometer attached to the underside of one of the cars. Temperatures taken from the Ryan chart agreed well with the mercury thermometer readings. The running time and delays together with a record of outside temperatures in transit are shown in table 4. This shows a total running time from GrandJunction to Invergrove (near Minneapolis) of 54 hours, of which 22 hours represented delays when the train was stopped and the fans in the fan cars consequently were not operating. The outside temperature records indicate rather moderate temperatures during transit with minima around 54°F. and maxima of 76°, 74°, and 83° (figure 2 and table 4).

To determine the influence of transit temperatures on the peaches, lugs of comparable fruit were placed in each of the test cars. The peaches for the test lots were picked from the same orchard and packed on the morning of August 28. As the fruit passed over the grader the riper fruit was sorted out and packed separately. One lug each of peaches of standard maturity and one of advanced maturity or ripeness was placed at the bottom bunker centerline, and one each at the top doorway centerline positions in each of the test cars. These positions represent the coldest and warmest positions in end-bunker cars. In the overhead bunker car the lugs were placed at the bottom quarterlength on the south side (when loaded) -- instead of at the bottom bunker centerline -- on the assumption that this was the coldest position in this type of car. Most of the peaches included in the standard maturity lots when pressure tested (5-1/16 inch plunger) registered between 10 and 13 pounds but averaged 9.5 pounds due to about 15 to 20 percent that were nearly tree ripe and registered less than 4 pounds. The ground color ranged from 3 on the USDA apple-pear color chart to a deeper yellow than 4 on that chart. In the advanced-maturity or ripe lots about 75 percent of the peaches registered less than 5 pounds pressure test and averaged 4.4 pounds. The average pressure test for this lot is not accurate as many of the fruits were too soft to register on the tester. The ground color of the riper peaches was usually a full deep yellow with possibly a tinge of green on one side.

Precooling was done by forced circulation of air through the bunker ice. In the fan car this was accomplished by operating the Preco fans with motors connected to the fan pulley on the outside of the car. This forced air up through the ice mass in the bunkers and delivered it out through the top bunker opening to the top of the load, reversing the normal direction of air circulation in standard refrigerator cars. (In transit the operation of the fans when the cars were in motion produced a similar forced circulation of air but when the cars were standing the circulation

was approximately the same as in standard cars). In the standard car without fans, precooling was done with a fan installed in the center of each top bunker opening with the remainder of the bunker opening closed by covering with heavy paper which was removed with the fans after precooling. These fans were operated by 1/4 H.P. motors and had a rated capacity of 3720 cubic feet per minute with free delivery. During precooling by both methods tested the floor space in the center bulkhead opening of the car was covered with paper so that the air would be forced down through the load. This paper was removed after precooling from the standard end-bunker car but was left in the fan car. The floor racks of the other fan cars were similarly papered during transit. At the time precooling started 3 percent (300 pounds) of salt was added to the bunker ice. Both cars were precooled for 9 hours.

Transit temperatures are usually highest in the top of the load and consequently the greatest amount of ripening and deterioration of the fruit occurs in the top layers. For the purpose of comparison in this preliminary report, therefore, the top centerline temperatures are given primary consideration and are the only ones plotted in the charts.

A record of the estimated amounts of ice and salt used to refrigerate these cars is shown in table 5.

## Results

The results of both unaccompanied and accompanied tests will be discussed together in order to consider all of the evidence obtained with respect to each phase of the investigation.

1. Effect of replenishing the ice at Grand Junction.

In the Mesa County district the procedure is to ice the cars at Grand Junction previous to loading. Until after the peak movement in 1946 none of the east-bound cars loaded east of Grand Junction were replenished before shipment but moved directly to Denver or Pueblo, for the first reicing. After the peak movement, when the peaches were assumed to be in a somewhat advanced stage of maturity all cars were reiced at Grand Junction. This delayed the movement of some of them out of the district, especially those loaded east of Grand Junction. This raised the question as to the importance of replenishing the ice at Grand Junction on the temperature of the peaches during transit and the effect on their rate of ripening and market quality. To obtain information on this point cars A, D, F, and G which were not reiced until they reached Denver can be compared with cars B, E, H, and I that were reiced at Grand Junction. The results are charted in figures 1 and 2. As shown in table 1, cars A and B were initially iced on August 23. The reiced car (B) was loaded and returned for reicing on the same day but was not actually reiced until 5:10 p.m. of the following day. Loading of car A was not completed until nearly noon of the following day, by which time the bunkers were only about half full of ice. The ice melted was probably largely used in cooling the part of a load (350 bushels) that was in the car overnight. There was no appreciable reduction in the rate of cooling

of the load at the top doorway in this car compared with that in the car (B) reiced at Grand Junction (Figure 1). Both cars were delayed; car A in being loaded and car B in being reiced. With fan cars information on the effect of replenishing the ice at Grand Junction instead of reicing at Denver can be had by comparing D and E which were loaded the same day they were initially iced. At the time loading was completed there was very little ice meltage as the bunkers of both cars appeared to be over 7/8 full. Car E was not reiced until nearly noon of the next day by which time its bunkers were only about half full. Car D moved directly out with nearly a full bunker of ice. Under these conditions little or no benefit from replenishing the ice at Grand Junction could be expected and none is indicated by the results in figure 1.

The cars loaded with lugs in the accompanied test (cars F vs. H and G vs. I) also showed no benefit from reicing at Grand Junction as compared with a first reicing at Denver (Figure 2). In this test the cars not reiced at Grand Junction moved out from Grand Junction in the same train as the cars reiced there, since it was necessary to have all test cars in the same train. However, the former were loaded late in the day so as to move with as little delay as possible after loading but did not leave until the following morning. At the time of the reicing at Grand Junction there was an estimated ice meltage of 2000 pounds in car F and 1800 pounds in car G (which was not replenished in either car) while car H was replenished with an estimated 2000 pounds and car I with 3100 pounds.

2. Effect of Precooling.

The effect of precooling on the average top centerline fruit temperature is shown in figure 3. In the standard end-bunker car the fans at the top bunker openings lowered the temperature to 50°F. (car K) from an initial temperature of 70° in 9 hours of precooling. The slight rise in temperature during the precooling period shown in the graph was due to a temporary disconnection of the fans to permit shifting of the cars. Following precooling the temperature rose again to 54°, due probably to equalization of the temperatures in the load. The fruit temperatures in the non-precooled standard end-bunker car (H) did not reach 54° until about 48 hours after loading and remained about 5° above the temperatures in the precooled car throughout the transit period.

Precooling by means of the Preco fans installed under the floor racks of the car caused even more cooling in the top centerline fruit (car L) than found in the precooled standard end-bunker car (car K). The average temperature in car L (figure 3) dropped to less than 45° and remained below 50°. With the fans continuing to operate in transit the temperature continued to drop fairly rapidly and was reduced to below 40° about 48 hours after loading. The temperatures in the non-precooled fan car also dropped rather rapidly and were reduced to slightly less than 40° before the end of the trip.

The reduced temperatures obtained quickly by precooling retards ripening and thus by keeping the fruit in a firmer condition tends to reduce bruising particularly in the top of the load.

3. Effect of salt with ice at reicings.

The effect of adding salt to the ice during reicing on the average top centerline fruit temperatures is shown in figure 4. The standard end-bunker car (M) had 300 pounds of salt added at the first reicing at Grand Junction, and 117 pounds at the second reicing at Denver. As shown in figure 4, the temperature in this car was 2 to 3 degrees lower than in the comparable car (H) without salt. The fan car (N) had salt added at all reicing stations as shown in table 5. The top centerline temperatures in this car also were 2 to 3 degrees below those in the fan car (I) without salt. These small differences in temperature could not be expected to make any appreciable difference in the rate of ripening of the fruit. After arrival at Minneapolis the fans no longer operated and the temperature at the bottom bunker position in the fan car (N) with salt dropped to 30°F. which is dangerously close to the freezing point of peaches (average 29.4°). These results indicate that when salt is used with the ice it should be added only during the early part of the trip.

4. Comparison of types of cars.

The effect of the type of refrigerator cars on the top fruit temperatures with shipments under standard refrigeration (ice replenished at Grand Junction) is shown in figure 5. The results show that by noon of the second day, the top temperatures in the overhead bunker car were 2.5° to 3°F. lower than those in the standard end-bunker car, but 5° to 10° higher than those in the fan car. The train did not leave Grand Junction until after 6:00 a.m. of the second day so the fans did not start operating until this time. By 1:00 p.m. of the second day the fans had operated less than 6 hours (due to delays), yet the average fruit temperature in the top layer of the fan car was reduced 6° below that in the overhead bunker car and 9° below that in the standard end-bunker car. Other comparisons between fan cars and standard end-bunker cars, with similar results, are shown in figures 2, 3, and 4. These results show that decided benefits can be obtained by using fan cars whenever they are available.

5. Comparison of cooling in cars loaded with peaches in bushel baskets and 16-pound lugs.

As shown in figure 6 the rate of cooling of peaches wrapped and packed in 16-pound lugs was about the same as that of peaches packed (unwrapped) in bushel baskets. This would indicate that the better carrying quality of peaches in lugs is due to the better protection of the fruit from bruising in the smaller package.

6. Effect of transit refrigeration on peaches wrapped and packed in lugs in shipments to Minneapolis.

Although test lugs of shipping-ripe and tree-ripe peaches were placed at the bottom bunker and top doorway positions in each car, the cars were unloaded over a period of several days

(September 2 to 5) so that it was impossible to make direct comparisons among the different lots. It was also impractical to make inspections the same length of time after unloading as it was necessary to be present at the unloading of some cars at times when inspection of lots from other cars should have been made.

For the reasons stated and probably also because of the variability in the fruit as packed at harvest little or no relation was found between the transit refrigeration treatments and the ripeness and bruising of the fruit when inspected at Minneapolis, (table 6). However, it is known from other investigations that lowered temperatures greatly retard ripening ( U.S.D.A. Tech. Bul. 680). The peaches of advanced maturity (nearly tree ripe) were too soft to pressure test on arrival. The standard maturity lots at the top doorway (TD) all averaged less than 3 pounds and many were too soft to pressure test. The average of all (standard maturity) lots from the top doorway position was only 1.8 pounds as contrasted with 6.0 pounds for those from the bottom bunker position and 9.5 pounds at harvest. The softer condition of the fruit from the top doorway was shown by the amount of bruising; the percentage of peaches from the top doorway that were bruised was double that in peaches from the bottom bunker in both the standard and the advanced maturity (tree-ripe) lots.

### 7. Comparison of lug-packed peaches of standard maturity and advanced maturity.

As shown in table 6 there were 3 times as many bruised peaches in the tree-ripe lots as in the lots of standard maturity. However, much of the fruit was only slightly to moderately bruised so that the general condition or marketability of many of the tree-ripe lots was good to very good, particularly of those from the bottom bunker position. The fruit picked at advanced maturity and loaded in the top of the load was full eating ripe but not overripe when unloaded. Because of softness and ripeness however, some of these lots were rather severely bruised and in only fair or poor condition. The advanced-maturity lots were of superior color and distinctly better eating quality, and, when not bruised excessively, would no doubt have brought a premium in retail sale, compared with peaches of standard shipping maturity.

## Discussion

With the standard end-bunker cars now available the only method that promptly and effectively reduced the temperatures in the top of the load enough to appreciably retard ripening in transit was precooling for at least nine hours. Fans installed at the top bunker opening can be used for precooling these loads. Precooling can be done in fan cars by attaching motors to the fan shaft. Precooling, however, would require the return to Grand Junction for reicing of cars loaded at Palisade and other stations east of Grand Junction.

Fan cars (not precooled before shipment) were also effective in quickly reducing the top temperatures after the cars started rolling. Used in this way the fan cars would not have to be delayed for precooling or reicing at Grand Junction. These cars are now

available to only a limited extent but the supply is being increased.

It was observed that fan cars may sometimes be loaded without the shipper being aware of the presence of the fans. Consequently they are billed without notation that the fans should be in the "on" position and the fans are left off. Shippers should be on the look out for fan cars and take advantage of them when available. The carriers could render a worthwhile service to shippers in this connection by notifying them when such cars are available so that they could be shipped with the fan "on" or used for pre-cooling if desired. Both methods would give better service than is now furnished by standard end-bunker cars customarily used.

The results in the overhead bunker car show that its effectiveness in providing desirable temperatures in thetop of the load was intermediate between that of standard end bunker cars and fans cars but in the bottom layers (see table 7) gave higher temperatures than the end-bunker cars and fan cars. From the standpoint of the load as a whole theoverhead bunker car did not seem to be any better than the end-bunker car and not as good as the fan car.

The results obtained from the test lots of peaches at different stages of maturity are not altogether conclusive. They seem to indicate chiefly that closer sorting at time of packing and segregation in the car are essential if riper peaches are to be shipped successfully without precooling. If adequately precooled, or if shipped in a fan car with the fans on, the indications are that they could be shipped successfully as now packed in the 16-pound lugs and without special segregation in the coldest part of the car. Excessive bruising would undoubtedly occur if ripe peaches were shipped in bushel baskets as the weight of the fruit would bruise and mash relatively soft fruit in the bottom of such large containers. The suitability of other types of containers reported to have given satisfactory results in the shipment of riper peaches in other parts of the country was not tested but would be desirable if this investigation is resumed another year.

Acknowledgements

This test was made possible by the generous cooperation of many organizations and individuals, particularly the following:

The shippers and receivers listed in Table 2.

Colorado Agricultural Experiment Station and Extension Service as represented by A. M. Binkley - Head, Department of Horticulture, Fort Collins, who assisted in planning and organizing the work; F. M. Green, Superintendent, Orchard Substation, Austin, who was responsible for the selection and packing of test lots; R. O. Woodfin County Agent, Grand Junction, who brought interested parties together to make plans for the tests.

Nebraska Agricultural Experiment Station as represented by H. O. Werner, Horticulturist, who received and inspected test lots in cars shipped to Lincoln, Nebraska.

Minnesota Agricultural Experiment Station as represented by J. D. Winter, Horticulturist and his assistant Mrs. Lillian Anderson, who provided facilities for holding and inspecting test lots from the cars shipped to Minneapolis.

Peach Board of Control - Oscar Jaynes, Executive Secretary, who arranged for supplying the test fruit used and coordinated the participation of local interests.

Carrol Wade from whose orchard the peaches for the test lots were obtained and Mrs. Carrol Wade who packed the test lots.

D. & R. G. W. Railroad - P. K. Yonge and C. W. Dickerson, Denver; G. W. Yeager and L. T. Wright, Grand Junction for special assistance in the handling of test cars, and for furnishing accommodations for the test party over this line.

C. R. I. & P. Railroad - J. M. Bann, Denver, Mr. L. D. Gorman, Denver, and H. D. Rissler, Chicago, for furnishing accommodations for the test party and assistance in conducting the test over their lines.

American Refrigerator Transit Company - J. A. Friend and Leonard Brown, St. Louis, for furnishing the type of ART cars specially needed in the tests, and general assistance in arranging and conducting the tests.

Burlington Refrigerator Express Company - H. B. Meinhardt, Chicago, and M. N. Weatherhead, Alexandria, Virginia, for furnishing 2 special cars desired and assistance in conducting the tests.

Preco, Inc. - E. A. Gorman, Chicago, for furnishing special motors needed to precool the fan cars and assistance in conducting the tests.

The test train was accompanied to destination by M. H. Haller - U. S. Department of Agriculture; Leonard Brown - American Refrigerator Transit Company; and M. N. Weatherhead, Burlington Refrigerator Express Company; and over their respective lines by P. K. Yonge - D. & R. G. W. Railroad and R. H. Rissler - C. R. I. & P. Railroad.

Table 1. Cars used in shipping tests with peaches from Western Colorado to Lincoln Nebraska

| Car | Type | Initially Iced | Load | Loading Started | Loading Completed | First Reicing at | Reiced at Grand Jct. Date | Time | Ice (pounds) | Unloading Started |
|---|---|---|---|---|---|---|---|---|---|---|
| A (ART 24254) | End bunker No fans | 8-23-46 | 528 bu. baskets | 8-23 7:30P | 8-24 11:30A | Denver, Colo. | -- | -- | -- | 8-26 4:30PM |
| B (ART 24566) | " | 8-23-46 | " | 8-23 2:15P | 8-23 7:15P | Grand Jct.Colo. | 8-24 | 5:10P | 4,300 | 8-26 8:30AM |
| C (ART 24203) | " | 8-23-46 | 1470 16 lbk lugs | 8-23 11:30A | 8-23 1:30P | " | 8-23 | 8:15P | 3,800 | 8-26 8:00AM |
| D (ART 35030) | End bunker Fans | 8-24-46 | 528 bu. baskets | 8-24 3:55P | 8-24 6:30P | Denver, Colo. | -- | -- | -- | 8-27 8:15AM |
| E (ART 35045) | " | 8-24-46 | " | 8-24 3:45P | 8-24 5:10P | Grand Jct.Colo. | 8-25 | 11:25A | 5,000 | 8-27 5:00PM |

Table 2. Cars used in transportation test with peaches from Western Colorado to Minneapolis.

| Car | Design | No. Lugs | Shipper 1/ | Loading Started | Loading Completed | Precooled | First Reicing at | Addition of Salt to ice. | Unloaded by | Unloading |
|---|---|---|---|---|---|---|---|---|---|---|
| F (ART 24667 | End Bunker | 1,400 | Cooperative Producers, Inc. Grand Junction | 2:35P | 3:45P | --- | Denver, Colo. | None | Twin City Fruit Co. | 9-4-46 8:30 AM to 11:30AM |
| G (ART 35037) | End bunker with fan | 1,400 | Pacific Fruit & Prod.Co. Grand Junction | 1:15P | 4:40P | --- | -"- | " | Gamble-Robinson Co. | 9-4-46 8:30 AM to 11:00AM |
| H (ART 24222) | End bunker | 1,470 | United Fruit Growers Co. Palisade | 2:30P | 5:00P | --- | Grand Junction, Colo. | " | Slocum-Bergren Co. | 9-5-46 9:00PM to 11:00PM |
| I (BREX 74698) | End bunker with fan | 1,400 | Cooperative Producers, Inc. Grand Junction | 1:00P | 2:30P | --- | " | " | Twin City Fruit Co. | 9-3-46 3:00PM to 5:45PM |
| J (BREX 74699) | Overhead bunker | 1,750 | United Fruit Growers Co. Palisade | 2:30P | 4:55P | --- | " | " | National Tea Co. | 9-2-46 9:50AM to 12:50PM |
| K (ART 24451) | End bunker | 1,400 | Cooperative Producers, Inc. Grand Junction | 10:35A | 1:30P | Bunker fans 1:30 PM to 9:30PM | " | 300# during precooling | Morris Fruit Co. | 9-4-46 5:00AM to 7:30AM |
| L (ART 35015) | End bunker with fan | 1,400 | Pacific Fruit & Prod. Co. Grand Junction | 9:15A | 12:45P | Preco fans 1:00 PM to 9:00PM | " | " | Gamble-Robinson Co. | 9-4-46 8:30AM to 11:30AM |
| M (ART 24576) | End bunker | 1,470 | United Fruit Growers Co. Palisade | 2:30P | 5:05P | --- | " | 3% first and second reicing(417 pounds) | Slocum-Bergren Co. | 9-5-46 7:30PM to 10:30PM |
| N (ART 35025) | End bunker with fan | 1,400 | Pacific Fruit & Prod. Co. Grand Junction | 10:10A | 3:50P | --- | " | 3% at all reicings(~~540~~ 540 pounds) | Gamble-Robinson Co. | 9-3-46 1:00PM to 3:00PM |

1/ Acknowledgment is made to Fred Powell, and Jim Toohig, of the Cooperative Producers, Inc. and to Dale Evans of the Pacific Fruit & Produce Co. and to John Teasdale of the United Fruit Growers Co. for their cooperation in providing the test cars.

Table 3. Position of electric resistance thermometers in loads of peaches from Colorado.

| Number | Position |
|---|---|
| 1 | Bottom-Bunker at centerline |
| 2 | " " " side |
| 3 | Top " " centerline |
| 4 | " " " side |
| 5 | Bottom-quarterlength-centerline |
| 6 | " " " side |
| 7 | Top " " centerline |
| 8 | " " " side |
| 9 | Bottom-quarterlength-centerline |
| 10 | " " " side |
| 11 | Top " " centerline |
| 12 | " " " side |

All thermometers were inserted in peaches at the side of the box. No air temperatures were taken inside of the cars.

Table 4. Running time and outside temperatures
Grand Junction, Colorado to Minneapolis, Minn.

| Station | 1946 Aug. Sept. Date | Arrive | Depart | Delay Hours | Delay Min. | Outside Temp. |
|---|---|---|---|---|---|---|
| Grand Junction | 8-29 | | 6:07A | | | |
| " E. Yd. | 29 | 6:20A | 6:30A | | 10 | |
| Cameo | 29 | 6:55A | 7:30A | | 15 | |
| Silt | 29 | 8:55A | 9:10A | | 15 | |
| Funston | 29 | 10:00A | 10:40A | | 40 | |
| Grizzly | 29 | 10:50A | 11:00A | | 10 | |
| Bond | 29 | 12:55P | 1:35P | | 40 | 75 |
| Flat | 29 | 3:20P | 3:40P | | 20 | |
| Tabernash | 29 | 4:50P | 6:10P | 1 | 20 | |
| Winter Park | 29 | 6:40P | 7:25P | | 45 | 57 |
| East Portal | 29 | 7:50P | 8:10P | | 20 | |
| Cliff | 29 | 8:40P | 8:55P | | 15 | |
| Plain | 29 | 9:40P | 9:55P | | 15 | |
| Leyden | 29 | 10:30P | 10:50P | | 20 | |
| Zuni | 29 | 11:20P | 11:45P | | 25 | 55 |
| Fox Jct. | 8-30 | 12:01A | 12:20A | | 19 | |
| Denver | 30 | 12:45A | 5:45A | 5 | 00 | |
| Limon | 30 | 10:00A | 10:43A | | 21 | |
| Stratton | 30 | 12:10P | 12:25P | | 15 | 74 |
| Goodland,Kansas | 30 | 1:34P | 2:50P | 1 | 16 | |
| Levant | 30 | 3:28P | 3:34P | | 6 | |
| Norton, Kansas | 30 | 5:15P | 5:25P | | 10 | 75 |
| Phillipsburg | 30 | 6:08P MT | 7:20P CT | | 12 | 73 |
| Belleville, Kansas | 30 | 9:30P | 11:48P | 2 | 18 | 65 |
| Fairbury,Nebraska | 8-31 | 12:42A | 12.56A | | 14 | |
| Co. Bluffs,Iowa | 31 | 5:00A | 7:20A | 2 | 20 | |
| Casey | 31 | 9:55A | 10:25A | | 30 | 72 |
| DesMoines | 31 | 12:05P | 1:43P | 1 | 38 | 85 |
| Sherman | 31 | 3:30P | 3:35P | | 5 | |
| Iowa Falls | 31 | 4:02P | 4:12P | | 10 | |
| Manly, Iowa | 31 | 5:45P | 7:05P | 2 | 20 | |
| Northwood,Iowa | 31 | 7:38P | 8:10P | | 32 | |
| Medford,Minn. | 31 | 9:55P | 9:58P | | 3 | |
| Faribault | 31 | 10:14P | 10:23P | | 9 | |
| Invergrove | 31 | 11:45P | | | | |
| Minneapolis Transfer | 9-1 | 2:30A | | | | |

Outside temperatures taken from Ryan chart

| | 8-28 | 8-29 | 8-30 | 8-31 | 9-1 | 9-2 | 9-3 | 9-4 |
|---|---|---|---|---|---|---|---|---|
| A.M. 2 A.M | -- | 65 | 54 | 56 | 52 | 50 | 48 | 58 |
| 4 | -- | 63 | 54 | 56 | 50 | 50 | 46 | 60 |
| 6 | -- | 62 | 54 | 54 | 50 | 50 | 46 | 60 |
| 8 | -- | 68 | 55 | 70 | 55 | 55 | 52 | 65 |
| 10 | -- | 66 | 66 | 82 | 58 | 58 | 60 | 70 |
| 12 Noon | 78 | 76 | 70 | 82 | 62 | 59 | 66 | 77 |
| P.M. 2 P.M. | 80 | 74 | 74 | 83 | 64 | 62 | 69 | 82 |
| 4 | 80 | 72 | 74 | 78 | 66 | 65 | 70 | 83 |
| 6 | 78 | 60 | 72 | 72 | 63 | 62 | 67 | -- |
| 8 | 73 | 52 | 66 | 65 | 59 | 58 | 64 | -- |
| 10 | 70 | 56 | 65 | 62 | 54 | 55 | 62 | -- |
| 12 Mdnt. | 67 | 54 | 60 | 56 | 52 | 52 | 58 | -- |

Table 5. Icing and salting records

| Station | Date | Time | Ice and salt[1] added to cars: F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pounds | pounds | pounds | pounds | pounds | pounds | pounds | pounds | pounds |
| Grand Jct. Colo.[2] | 8-28 | 7:30 A to 9:00A | 10,000 | 10,000 | 10,000 | 9,600 | 7,800 | 10,000 (300) | 10,000 (300) | 10,000 | 10,000 |
| " " " | 8-28 to 8-29 | 10:45P 2:42 | --- | --- | 2,000 | 3,100 | 2,100 | 3,700 | 4,400 | 2,700 (300) | 3,100 (300) |
| Denver, Colo. | 8-30 | 3:40 4:37A | 5,800 | 6,800 | 4,100 | 3,800 | 5,600 | 2,900 | 3,800 | 3,900 (117) | 3,300 (114) |
| Belleville, Kansas | 8-30 | 9:55P 10:25P | 2,000 | 2,200 | 2,100 | 3,000 | 2,900 | 1,700 | 1,800 | 2,100 | 2,400 (72) |
| Manly, Iowa | 8-31 | 7:00P | 1,800 | 2,100 | 1,800 | 1,800 | 2,800 | 1,000 | 1,600 | 1,700 | 1,800 (54) |
| Minneaplois, Minn. | | | 9-2 1:30A 2,100 | --- | 9-3 10:30A 3,000 | 9-2 1:30A 2,000 | -- | -- | -- | 9-4 11:30A 4,000 | -- |
| TOTAL Ice (Salt) | | | 21,700 | 21,100 | 23,000 | 23,300 | 21,200 | 19,300 (300) | 21,600 (300) | 24,400 (417) | 21,100 (540) |
| Est remaining | | [3] | 8,000 | 6,100 | 6,700 | 8,200 | 5,000 | 6,900 | 6,100 | 8,600 | 7,500 |
| Est. Meltage | | | 13,700 | 15,000 | 16,300 | 15,100 | 16,200 | 12,400 | 15,500 | 15,800 | 13,600 |

1/ Figures in parenthesis show salt added. In cars K and L the salt was not added until precooling started.
2/ Initial icing before loading.
3/ Time of taking ice meltage records - Car F, 9/4-11:30 AM, Car G, 9/4-11:00AM, Car H, 9/5-9:00PM, Car I, 9/3-3:00PM Car J, 9/2-8:30AM, Car K, 9/4-5:00AM, Car L, 9/4-8:30AM, Car M, 9/5-7:30PM, Car N, 9/3-1:00PM

TABLE 6.

| Car | Type of car | Treatment | Unloaded Date Time Ended | Pressure Test Standard Maturity Date | Pressure Test Standard Maturity B.B. 1/ | Pressure Test Standard Maturity T.D. 2/ | Ripe Peaches Standard Maturity Date | Ripe Peaches Standard Maturity B.B. | Ripe Peaches Standard Maturity T.D. | Ripe Peaches Advanced Maturity Date | Ripe Peaches Advanced Maturity B.B. | Ripe Peaches Advanced Maturity T.D. | Bruised Peaches Standard Maturity Date | Bruised Peaches Standard Maturity B.B. | Bruised Peaches Standard Maturity T.D. | Bruised Peaches Advanced Maturity Date | Bruised Peaches Advanced Maturity B.B. | Bruised Peaches Advanced Maturity T.D. | Marketability when inspected 3/ Standard Maturity Date | Standard Maturity B.B. | Standard Maturity T.D. | Advanced Maturity Date | Advanced Maturity B.B. | Advanced Maturity T.D. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lbs. | Lbs. | | % | % | | % | % | | % | % | | % | % | | | | | | |
| | | At harvest | | 8/28 | 9.5 | | | | | | | | | | | | | | | | | | | |
| F | Std. | Ice not replenished | 9/4 11:30A | 9/4 | 6.5 | 2.5 | 9/6 | 48 | 58 | 9/4<br>9/5 | 57 | <br>100 | 9/6 | 3 | 13 | 9/4<br>9/5 | 7 | <br>48 | 9/6 | VG | G | 9/4<br>9/5 | G | <br>F - P |
| G | Fan | Do. | 9/4 11:00A | 9/4 | 7.3 | 2.8 | 9/6 | 60 | 62 | 9/6 | 96 | 95 | 9/6 | 14 | 16 | 9/6 | 18 | 27 | 9/6 | VG | G | 9/6 | VG | G - VG |
| H | Std. | Ice replen. | 9/3 11:00P | 9/6 | 4.2 | 1.3 | 9/7 | 30 | 51 | 9/6 | 57 | 100 | 9/7 | 18 | 20 | 9/6 | 31 | 57 | 9/7 | VG | G-VG | 9/6 | G | P |
| I | Fan | Do. | 9/3 4/ 6:00P | 9/4 | 5.1 | 2.6 | 9/6 | 62 | 49 | 9/5 | 100 | 96 | 9/6 | 6 | 18 | 9/5 | 41 | 38 | 9/6 | G | F | 9/5 | F | F |
| J | O.B. | Do. | 9/2 12:30P | - | - | - | 9/4 | 60 | 60 | 9/4 | 100 | 100 | 9/4 | 12 | 18 | 9/4 | 32 | 40 | 9/4 | G | G | 9/4 | G | G |
| K | Std. | Precooled Ice replen. | 9/4 7:30A | 9/4 | 8.0 | 1.8 | 9/6 | 47 | 58 | 9/5 | 82 | 96 | 9/6 | 2 | 13 | 9/5 | 14 | 61 | 9/6 | VG | G-VG | 9/5 | G-VG | P |
| L | Fan | Do. | 9/4 11:00A | 9/4 | 7.8 | 2.6 | 9/6 | 47 | 75 | 9/6<br>9/5 | 100 | <br>96 | 9/6 | 0 | 13 | 9/6<br>9/5 | 19 | <br>33 | 9/6 | VG | G-VG | 9/6<br>9/5 | VG | <br>F - G |
| M | Std. | Ice replen. +3% salt | 9/5 10:00P | 9/6 | 4.5 | 0.5 | 9/7 | 30 | 45 | 9/6 | 68 | 96 | 9/7 | 6 | 13 | 9/6 | 31 | 51 | 9/7 | VG | FG | 9/6 | G | F |
| N | Fan | Do. | 9/3 4/ 3:00P | 9/4 | 4.6 | 0.5 | 9/6 | 42 | 73 | 9/5 | 75 | 95 | 9/6 | 4 | 14 | 9/5 | 18 | 40 | 9/6 | VG | G-VG | 9/5 | G | F - P |
| | | Average | | | 6.0 | 1.8 | | 47 | 59 | | 82 | 97 | | 7 | 15 | | 23 | 44 | | | | | | |

1/ B.B - Bottom bunker position.

2/ T.D. - Top doorway position.

3/ VG - Very good, G - Good, F - Fair, P - Poor.

4/ Lots unloaded on September 3 were placed in cold storage overnight.

TABLE 6. Conditions of Peaches After Shipment.

Table 7. Average fruit temperatures in the top layer and in the bottom layer (Average of 6 positions:- centerline and side wall at bunker, quarterlength and doorway)

| Place | Date | Time | Car F Top °F | Car F Bot. °F | Car G Top °F | Car G Bot. °F | Car H Top °F | Car H Bot. °F | Car I Top °F | Car I Bot. °F | Car J Top °F | Car J Bot. °F | Car K Top °F | Car K Bot. °F | Car L Top °F | Car L Bot. °F | Car M Top °F | Car M Bot. °F | Car N Top °F | Car N Bot. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grand Junction, Colo. | Aug.28 | 12:30P | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 68.5 | 59.6 5/ | ---- 5/ | ---- | ---- | ---- | ---- | ---- |
| " | | 1:00-1:30P | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 70.2 5/ | 61.8 | ---- | ---- | ---- | ---- |
| " | | 2:00-2:30P | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 58.6 5/ | 57.3 | ---- | ---- | ---- | ---- |
| " | | 3:00-3:30P | ---- | ---- | ---- | ---- | ---- | ---- | 70.7 | 62.3 | ---- | ---- | 54.4 | 55.8 5/ | 54.3 5/ | 54.3 | ---- | ---- | 73.6 | 63.4 |
| " | | 4:00-4:30P | 72.7 | 63.1 | 69.1 | 62.6 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 52.0 5/ | 52.9 | ---- | ---- | 72.8 | 61.0 |
| " | | 5:00-5:30P | ---- | ---- | 69.0 | 59.8 | ---- | ---- | ---- | ---- | ---- | ---- | 56.0 | 54.3 5/ | 49.2 5/ | 50.7 | ---- | ---- | 71.8 | 59.1 |
| Grand Junction | | 6:00- | | | | | | | | | | | | | | | | | | |
| Palisades, Colo. | | 6:30P | ---- | ---- | ---- | ---- | 70.5 | 61.8 | ---- | ---- | 66.2 | 65.7 | ---- | ---- | ---- | ---- | 69.7 | 65.7 | ---- | ---- |
| Grand Junction, Colo. | | 7:00-7:30P | ---- 4/ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 49.2 | 50.9 5/ | 44.9 | 46.5 | ---- | ---- | ---- | ---- |
| " | | 9:00-9:30P | 65.5 4/ | 55.1 | ---- | ---- | ---- | ---- | 67.2 | 51.8 | ---- | ---- | 48.3 | 50.2 5/ | 44.2 | 46.8 | ---- | ---- | ---- | ---- |
| " | | 10:00-10:30P | ---- | ---- | ---- | ---- | 66.0 | 55.5 | ---- | ---- | 62.2 | 62.6 | ---- | ---- | ---- | ---- | 66.6 | 59.7 | ---- | ---- |
| " | | 11:00-11:30P | ---- | ---- | 65.8 | 51.0 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 68.3 | 52.2 |
| " | Aug.29 | 12:15A | 64.2 | 52.3 | ---- | ---- | ---- | ---- | 65.8 | 50.6 | ---- | ---- | 52.7 | 46.9 5/ | ---- | ---- | ---- | ---- | ---- | ---- |
| " | | 2:30A | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 49.8 5/ | 44.4 | ---- | ---- | ---- | ---- |
| Bond, Colo. | | 1:00P | 59.7 4/ | 47.8 | 52.8 | 48.3 | 59.6 | 47.2 | 50.3 | 47.1 | 56.6 | 53.1 | 52.0 | 42.4 4/ | 44.2 5/ | 44.4 | 58.4 | 45.3 | 50.6 | 46.5 |
| Denver, Colo. | Aug.30 | 1:00A | 57.4 4/ | 45.3 | 50.1 | 46.7 | 57.3 | 44.2 | 49.8 | 46.3 | 53.8 | 50.5 | 50.7 | 41.3 5/ | 42.8 5/ | 42.4 | 55.3 | 42.3 | 48.5 | 44.7 |
| Goodland, Kansas | | 2:00P | 53.0 | 42.9 | 43.8 | 42.1 | 53.5 | 42.2 | 43.7 | 41.5 | 50.1 | 47.2 | 48.8 | 40.5 4/ | 39.0 5/ | 40.0 | 51.2 | 39.9 | 41.0 | 40.3 |
| Belleville, Kansas | | 10:00P | 51.8 | 41.3 | 41.8 | 40.9 | 53.5 | 41.8 | 40.0 | 40.0 | 49.2 | 46.4 | 47.8 | 40.4 5/ | 38.2 5/ | 38.8 | 50.0 | 38.8 | 39.1 | 38.8 |
| DesMoines, Iowa | Aug.31 | 12:30P | 48.7 | 39.6 | 39.8 | 39.0 | 51.1 | 40.5 | 38.3 | 38.0 | 47.0 | 44.6 | 45.9 | 39.2 5/ | 37.8 5/ | 38.8 | 48.3 | 39.0 | 37.0 | 37.0 |
| Manly, Iowa | | 6:00P | 48.9 | 39.9 | 39.3 | 39.1 | 50.9 | 40.3 | 38.9 | 38.3 | 46.7 | 44.0 | 46.8 | 38.9 4/ | 37.9 5/ | 38.8 | 48.1 | 38.8 | 37.5 | 37.9 |
| Invergrove, Minn. | Sept.1 | 12:15A | 48.1 | 39.8 | 38.5 | 38.0 | 49.5 | 39.9 | 38.5 | 38.3 | 45.4 | 43.5 | 45.6 | 38.4 4/ | 37.0 5/ | 37.7 | 46.9 | 38.7 | 35.1 | 35.6 |
| Minn.Trans., Minn. | | 2:00-2:30P | 46.3 | 38.7 | 40.0 | 36.8 | 47.3 | 38.2 | 40.8 | 36.9 | 44.8 | 43.1 | 42.9 | 37.0 5/ | 38.4 5/ | 36.8 | 44.8 | 37.6 | 37.3 | 33.6 |
| Minneapolis, Minn. | Sept.2 | 8:30A | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 41.3 | 40.0 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| | | 6:30P | ---- | ---- | 41.8 | 35.5 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 40.5 5/ | 35.9 | ---- | ---- | 39.1 | 33.5 |
| | Sept.3 | 6:00A | 41.7 | 36.7 | ---- | ---- | ---- | ---- | 40.9 | 36.0 | ---- | ---- | 40.4 | 35.7 5/ | ---- | ---- | ---- | ---- | ---- | ---- |
| | | 12:15P | ---- | ---- | 40.8 | 34.8 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 40.0 5/ | 35.4 | ---- | ---- | 39.7 | 34.6 |
| | Sept.4 | 3:30A | ---- | ---- | 42.8 | 36.3 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 42.9 5/ | 37.9 | ---- | ---- | ---- | ---- |
| | | 2:30P | ---- | ---- | ---- | ---- | 45.5 | 37.5 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 43.0 | 37.2 | ---- | ---- |

5/ and 4/:-- These numbers indicate the number of figures averaged. All other averages of 6 figures.

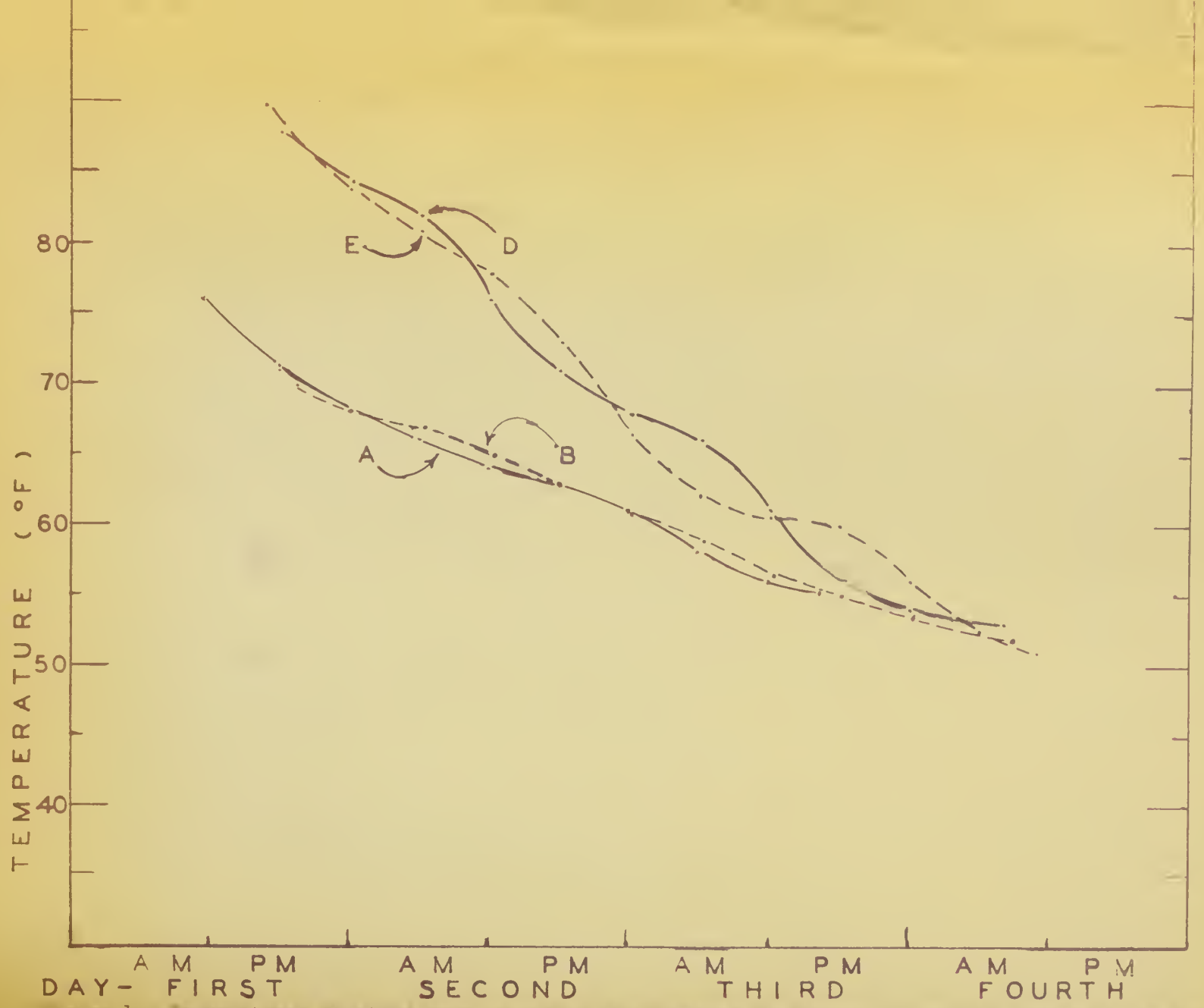
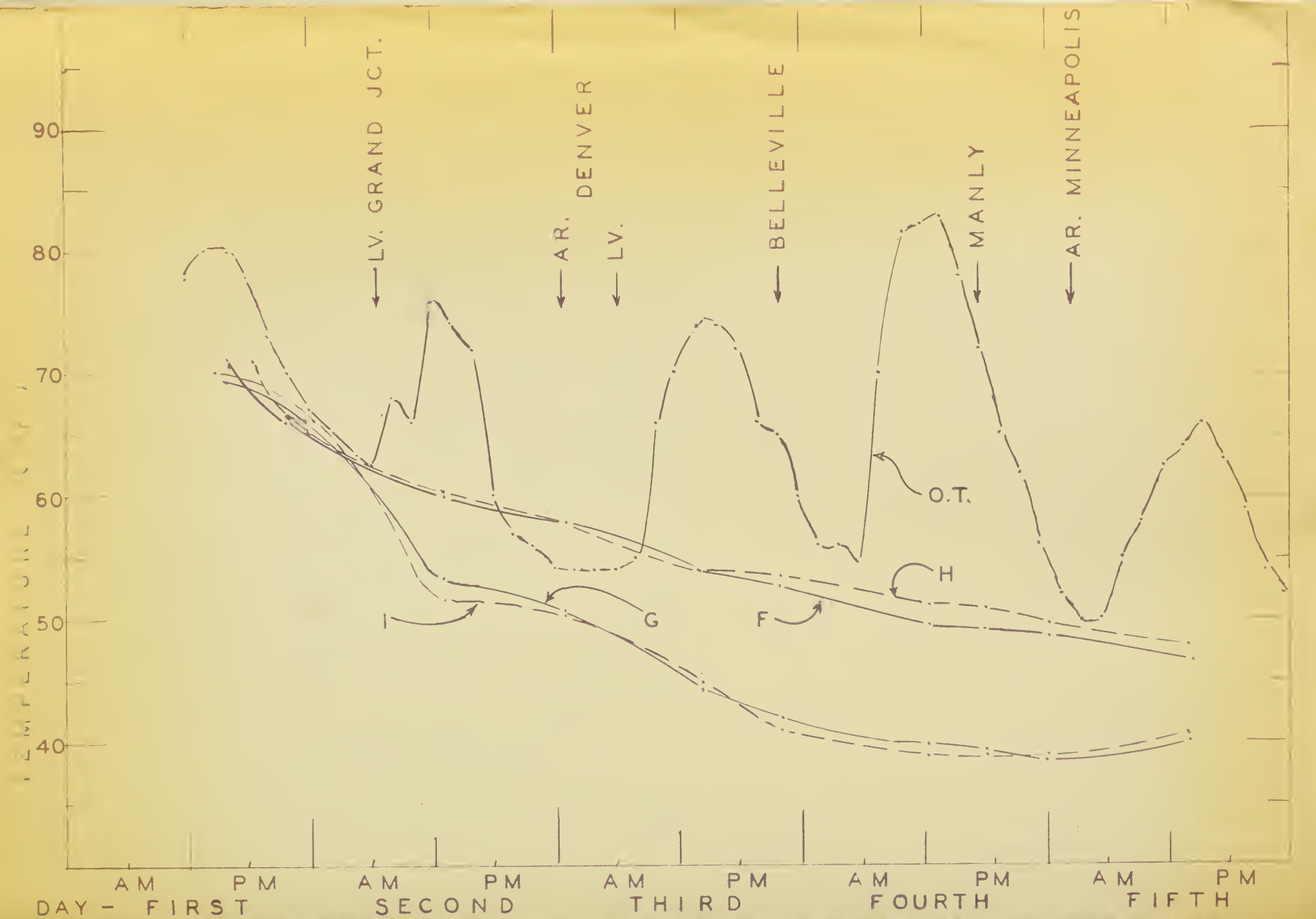

TEMPERATURE (°F)
80
70
60
50
40
E
D
A
B
A M
P M
A M
P M
A M
P M
A M
P M
DAY- FIRST
SECOND
THIRD
FOURTH

Figure 1.


LV. GRAND JCT.
AR. DENVER
LV.
BELLEVILLE
MANLY
AR. MINNEAPOLIS
O.T.
H
G
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I
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80
70
60
50
40
AM
PM
DAY – FIRST
SECOND
THIRD
FOURTH
FIFTH

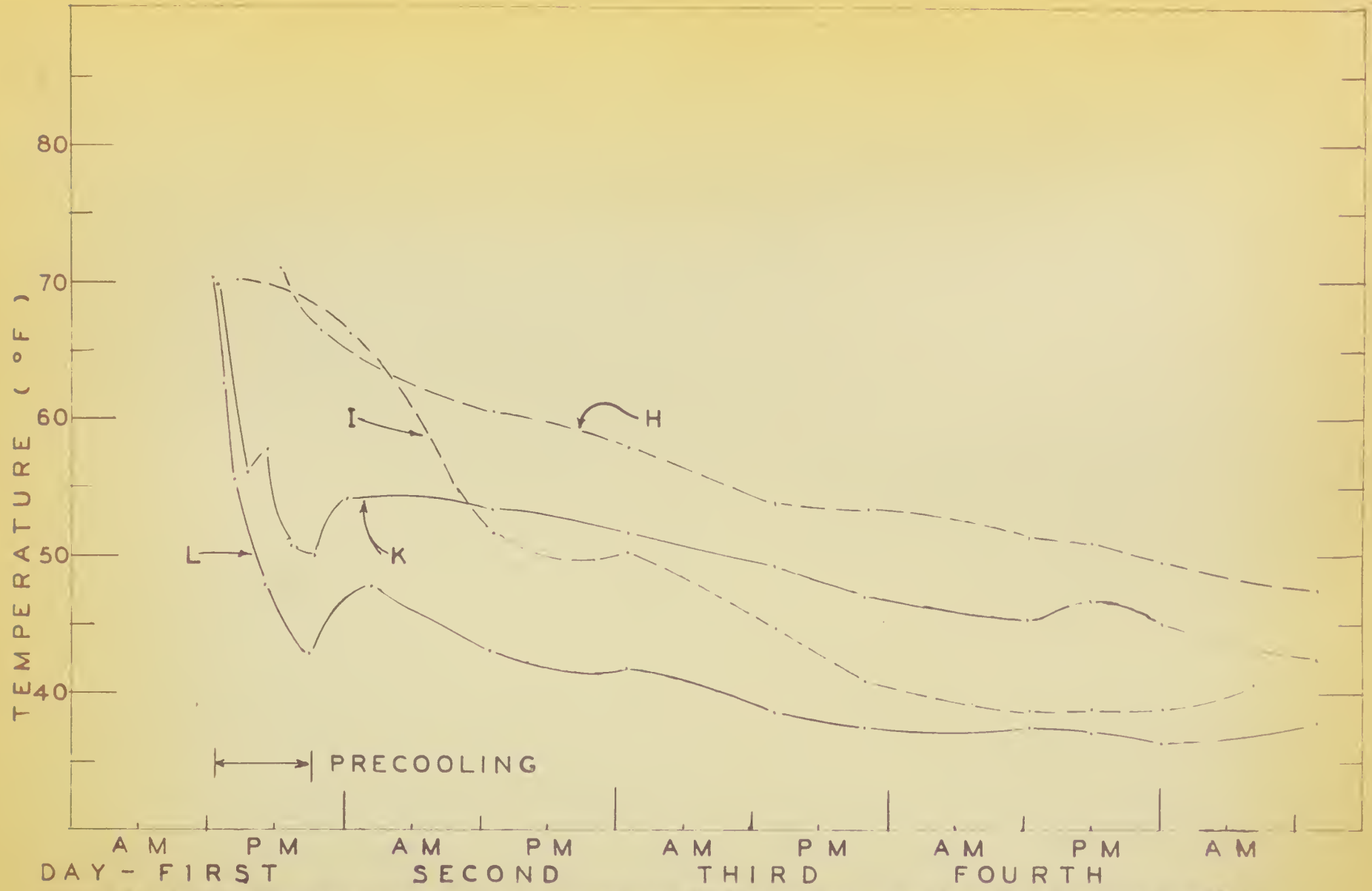
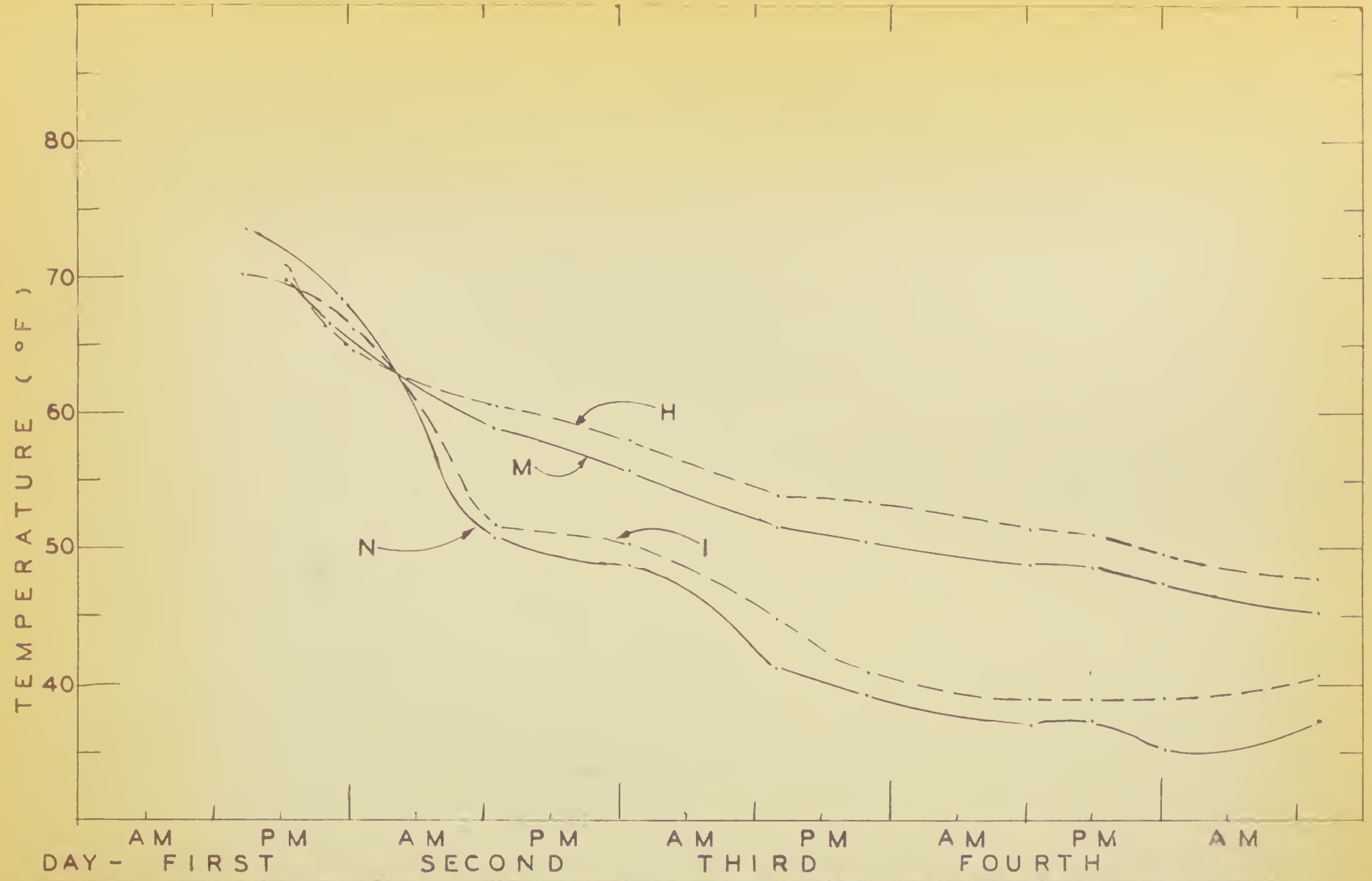
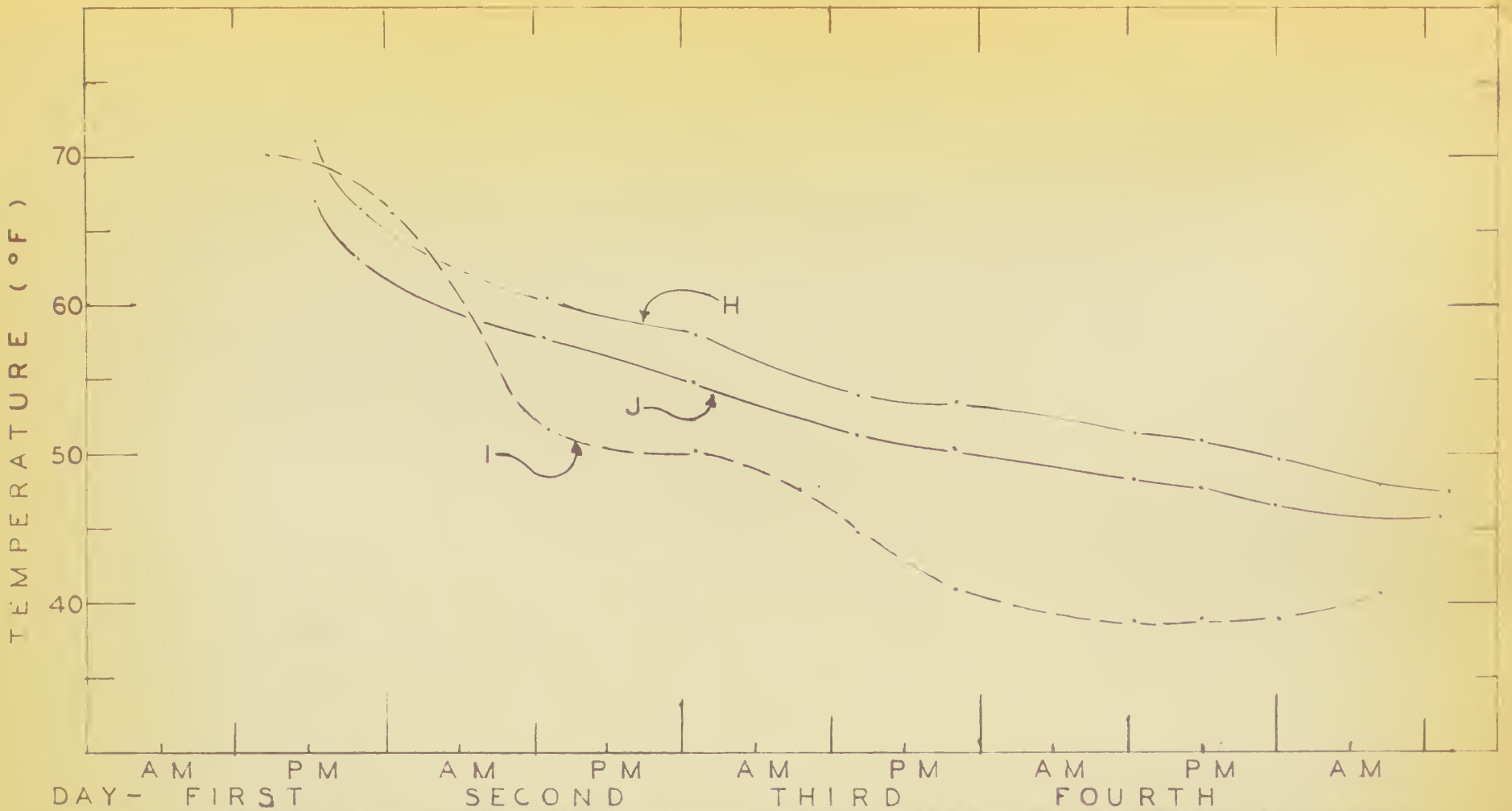


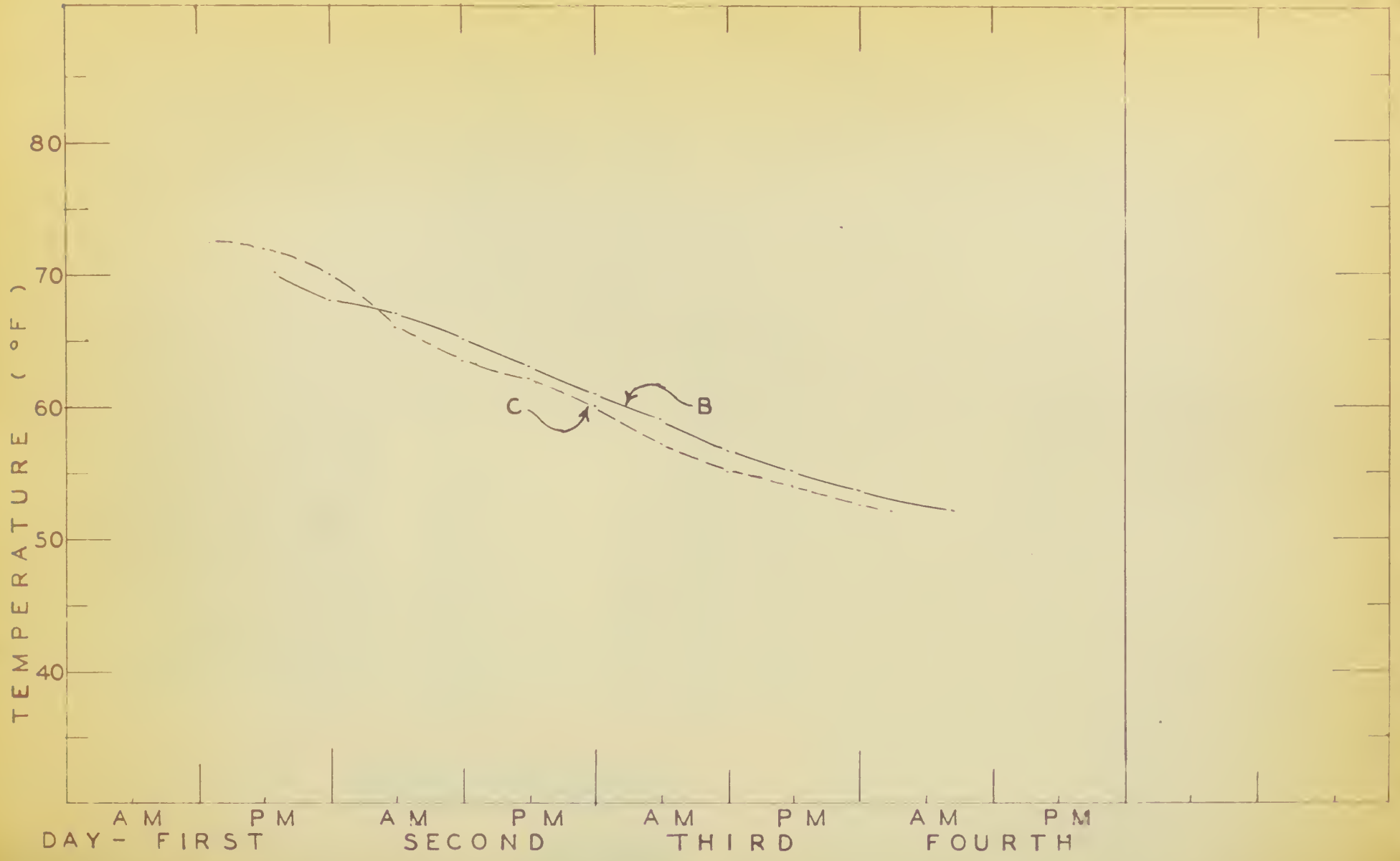

Figure 2. Average top corner-line commodity temperatures during precooling and transit of peaches from Mesa County, Colorado to Minneapolis, Minnesota.

H- end-bunker car not precooled.
K- End-bunker car precooled.
I- End-bunker fan car not precooled.
L- End-bunker fan car precooled.




and similar cars equipped with ice.
H- Ice-bunker car - No salt.
M- Ice-bunker car - 3% salt at first icing.
N- Ice-bunker tan car - No salt.
I- Refrigerator car - 3% salt at first icing.


TEMPERATURE (°F)
70
60
50
40
H
J
I
AM
PM
AM
PM
AM
PM
AM
PM
AM
DAY- FIRST
SECOND
THIRD
FOURTH


80
70
60
50
40
TEMPERATURE (°F)
C
B
A M
P M
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P M
A M
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A M
P M
DAY - FIRST
SECOND
THIRD
FOURTH